NOAA Research to Operations Polar Satellite Series

Polar Satellite Ground Segment

NOAA Polar Ground Segment Requirements for the Ocean Surface Topography Mission (OSTM)

September 19, 2005

Prepared by:
U.S. Department of Commerce
National Oceanic and Atmospheric Administration (NOAA)
National Environmental Satellite, Data, and Information Service (NESDIS)

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Preface

This document comprises the NOAA/NESDIS baseline publication of the NOAA Polar Ground Segment (NPGS) Requirements for the Ocean Surface Topography Mission (OSTM)/Jason-2. This document is Revision 0, DCN 0 (document number NO-NRTOPS/OSD-2004-000XR0U0).

This document contains the baseline NOAA OSTM/Jason-2 ground segment requirements that are applicable to upgrade the overall functionality, performance, design, interface and operations of the NPGS to support the OSTM/Jason-2 mission. The requirements stated in this document provide the basis for decomposition and allocation of requirements to the elements of the NPGS and to system interfaces. The intent is to provide a baseline for NPGS upgrades needed to support the OSTM and sustain it over its lifecycle.

Future updates and revisions to this document will be produced and controlled by NOAA/NESDIS/OSD.

1 Introduction

The National Oceanic and Atmospheric Administration (NOAA) and the National Aeronautics and Space Administration (NASA) of the United States have entered into a Memorandum of Understanding (MOU) with The Centre Nationale D'Etudes Spatiales (CNES) of France and the European Organisation for the Exploitation of Meteorological Satellites (EUMETSAT) for participation in the Ocean Surface Topography Mission (OSTM). NOAA has agreed to provide support from its polar satellite ground segment capabilities for the Jason-2 Satellite to acquire, produce, and distribute geophysical data and products in a manner beneficial to all partners and the world's meteorological community. In addition, NOAA may be requested by its partners to provide support using the NOAA Polar Ground Segment during the Launch and Early Orbit, Verification, and Assessment Phases. NOAA will support the mission with the capabilities of the NOAA Polar Ground Segment (NPGS) as defined in this document.

The OSTM/Jason-2 system is comprised of four segments. They are the Launch Support Segment, the Space Segment, Ground Segment, and the Customer Segment. The Launch Support Segment, consisting of a launch vehicle and launch services, are provided by NASA. The space segment/Jason-2 satellite is provided by CNES, with spacecraft and instrument components provided by both CNES and NASA. The OSTM ground segment is comprised of the integrated ground segment capabilities of NOAA, NASA, CNES and EUMETSAT.

The primary NPGS elements that will be affected by OSTM are the Command and Data Acquisition Stations (CDAS) at Wallops Virginia and Fairbanks Alaska, the Satellite Operations Control Center (SOCC) and the Environmental Satellite data Processing Center (ESPC), formerly called the Central Environmental Satellite Computer System (CEMSCS), both located in Suitland Maryland, and internal and external communications interfaces and services. Long-term Archive and Access Services (AAS) will be provided by NOAA's Comprehensive Large Array-data Stewardship System (CLASS). CLASS is combination of information storage and access systems supported by several of the NOAA National Data Centers. There are currently two instances of CLASS: one located in Suitland Maryland and another in Asheville North Carolina. All NOAA ground segment elements shall maintain their continued support of the heritage NOAA Polar Satellite System without impact on the NOAA Polar missions they support.

1.1 Purpose

The purpose of this document is to establish the OSTM/Jason-2 requirements that are applicable to the NPGS upgrade/modifications and its overall functionality, performance, design and operations to support the OSTM/Jason-2 services as required by the MOU. The requirements defined in this document provide the basis for further allocation of requirements within NPGS elements and to system interfaces.

The requirements in this document are levied by the Polar Program Office for the acquisition and development of capabilities needed to execute OSTM. Acquisition and development organizations shall incorporate these requirements in to their overall system upgrade activities in accordance with their respective requirement processes.

This document provides the baseline against which the NPGS will be verified and validated as ready to support the OSTM.

1.2 Scope

In support of the OSTM, NOAA is responsible for performing ground segment functions assigned to the Satellite Operations Control Center, Command and Data Acquisition Stations, and the data processing, archival and distribution centers. The NPGS will be upgraded to support NOAA's OSTM responsibilities.

The scope of the NPGS upgrade is defined by the NPGS requirements. The scope includes the following:

- Capability upgrades at the CDAS, the SOCC, ESPC, and CLASS.
- Installation, integration, and test of all upgrades, including Government Furnished Equipment (GFE), Software (GFS), and Communications (GFC)
- Acquisition and development of capabilities needed for fulfillment of these requirements
- End-to-end (ETE) NPGS testing and evaluation, and support during joint system (OSTM) end-to-end testing between partners.
- Regression testing of legacy system capabilities to assure that they are not affected by the OSTM upgrades.

1.3 Document Organization

The document is organized as follows:

- Section 1.4 lists the applicable and reference documentation that provide source and input information to the scope of requirements on the NPGS.
- Section 2 describes the NOAA Information Service Enterprise (ISE) objectives that will be supported in the OSTM time period and a brief description of the baseline Polar ground segment elements that form the basis for this service.
- Section 3 provides formal requirement statements.
- Section 4 describes the verification and validation requirements.
- Appendices include: Requirement Traceability and Verification Matrix; and the Acronyms List.

1.4 Applicable and Reference Documentation

In addition to the associated Statement of Work for the OSTM/Jason-2 project, **Table 1-1** presents a list of Applicable Documents (AD-#) that contain information and/or requirements that need to be applied for the successful completion of the OSTM/Jason-2 program. In case of conflict between requirements in this document and any listed applicable document, then this document takes precedence as the source for NOAA requirements.

Document reference numbers are based on the NOAA OSTM Ground Segment Documentation Reference List, maintained by OSD.

Table 1-1 Applicable Documents

Doc #	Title	Reference Number	Issue	Date
AD-1	Deleted			
AD-2	OSTM/Jason-2 Ground System Requirements, Architecture and Operations Concepts	TP3-JS-STB-110-CNES		Draft July 19, 2004
AD-3	Jason-2 Satellite to Ground Interface Specification	TB3-LB/LS-IF-53-CNES	Iss-1 R.0	9 May 2005
AD-4	Deleted			
AD-5	NOAA Security Requirements	http://www.cio.noaa.gov/		As Referenced on Web Site
AD-6	Packet Telemetry Standard	ESA PSS-04-106		Jan 1, 1988
AD-7	Packet Telecommand Standard	ESA PSS-04-107		2 April 1992
AD-8	Telemetry Channel Coding Standard	ESA PSS-04-103		1 Sept 1989
AD-9	Time Code Formats	CCSDS 301.0-B-2		Jan 2002
AD-10	Consultative Committee for Space Data Systems, REPORT CONCERNING SPACE DATA SYSTEM STANDARDS, TELECOMMAND, SUMMARY OF CONCEPT AND RATIONALE (Green Book)	CCSDS 200.0-G-6	Issue 6	Jan 1987
AD-11	Deleted			
AD-12	Reserved			

1.5 Reference Documentation

Table 1-2 presents a list of Reference Documents (RD-#) that provide additional useful information for successful program implementation. As before, the document reference numbers are based on the NOAA OSTM Ground Segment Documentation Reference List, maintained by OSD.

Table 1-2 Reference Documents

Doc #	Title	Reference Number	Issue	Date
RD-1	Deleted			
RD-2	Reserved			
RD-3	Deleted			~~10 June 2005~~
RD-4	Jason-1 Sequencing and Scheduling Subsystem (JSEQ) Software Operations Manual	TP2-UG-JSEQ-5303-JPL	VER. 3.0	Oct. 17, 2000
RD-5	Reserved			
RD-6	Deleted			
RD-7	Reserved			
RD-8	OSTM/Jason2 English/French Glossary of Terms and Acronyms	TP3-J0-NT-97-CNES	Ver 0	Mar.15, 2004
RD-9	Deleted			
RD-10	Deleted			
RD-11	Deleted			
RD-12	Reserved			
RD-13	Deleted			
RD-14	Deleted			
RD-15	Reserved			

2 NOAA Polar Ground Segment for OSTM

Within the United States Government, NOAA has operated and maintained civilian Polar and Geostationary satellite systems for many years to collect, process, distribute and store environmental data records to meet the needs of the Government, a growing user community, and the World Meteorological Community. Over the years, NOAA has established significant operational satellite ground segment capabilities to support its mission.

NOAA also conducts continuing research projects in assessing new instrument capabilities from future satellites, non-NOAA satellites, and other platform/sources to ensure that it can continue to meet the growing demands for environmental data by users.

The OSTM project will allow NOAA to make additional use of its established Operational Polar Satellite Ground Segment capabilities as envisioned during the mission time frame. It also supports NOAA's commitments with NASA on "Research to Operations" where early operational use and experiences will be gained through the use of research satellites, once their research goals have been satisfied.

2.1 NOAA Polar Ground System Vision

In the NOAA Strategic Plan, NOAA identifies four mission strategies to meet its observing system vision and future mission needs:

- ***Monitor and observe*** the land, sea, atmosphere, and space and create a data collection network to track Earth's changing environment.
- ***Understand and describe*** how the Earth's environment and its natural systems work together through investigation and interpretation of information.
- ***Assess and predict*** the changes in the Earth's environment, and provide information about the future.
- ***Engage, advise, and inform*** the public, consisting of individuals, partners, communities, and industries, to facilitate information flow, assure coordination and cooperation, and provide assistance in the use, evaluation, and application of information.

As shown in Figure 2.1, these mission strategies form the basis of the NOAA Information Service Enterprise. NOAA's national and international commitments for providing global environmental data are the responsibility of the National Environmental Satellite, Data, and Information Service (NESDIS). NESDIS is responsible for establishing and operating civil operational satellite systems that acquire process, validate, distribute and store environmental data on the earths changing environment. During OSTM on-orbit operations, NESDIS will be evolving to an end-to-end Information Service Enterprise. Using this enterprise approach, NESDIS will address changing user needs, the increases in data volumes to be collected and processed, the timelines requirements for making data available to national and international users, and providing improved customer services.

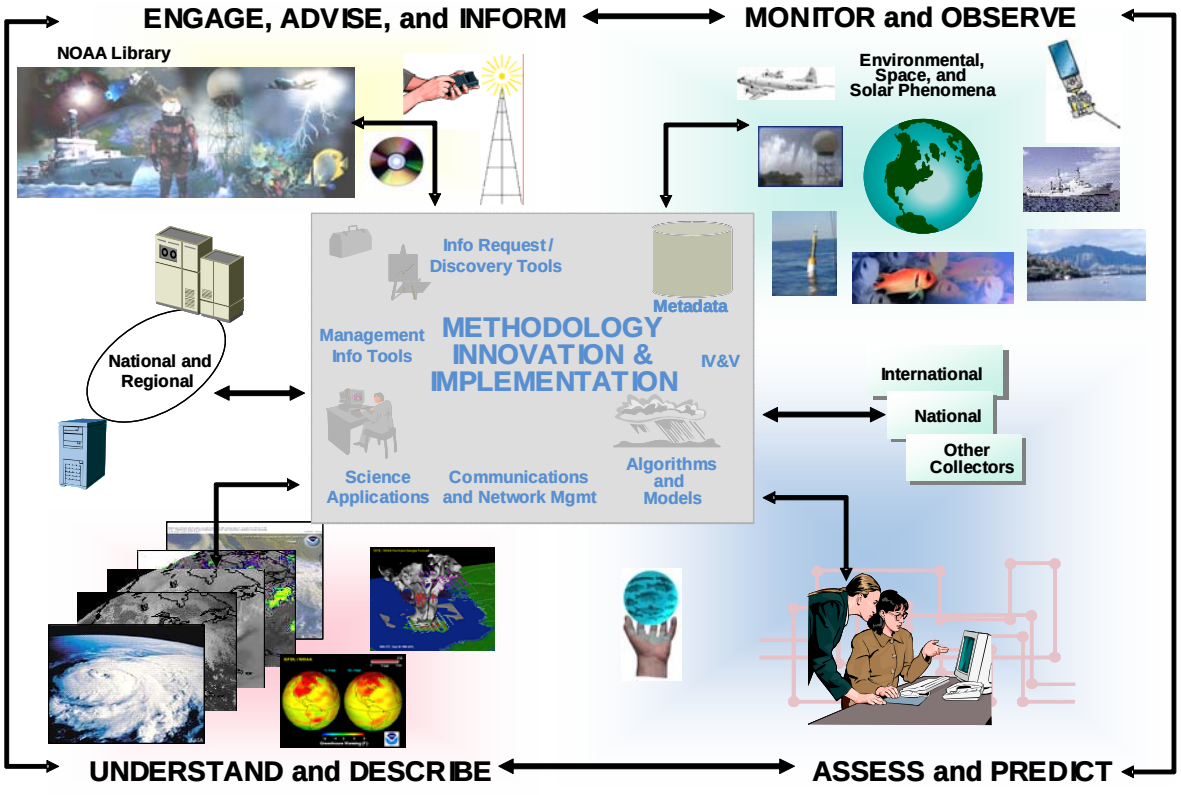

Figure 2.1 NOAA Information Service Enterprise

Operational Global sea surface topography (sea level measurements) is one of the environmental data records approved to be included in the future NOAA Information Service Enterprise, as documented in the National Polar-orbiting Operational Environmental Satellite System (NPOESS) Integrated Operational Requirements Document (IORD)-II.. As a scientific research mission, the Topex/Poseidon altimeter mission has been focused on the collection of Global sea surface topography measurements using a satellite based radar altimeter instrument. The latest series of satellites based on the Topex/Poseidon mission experiences is incorporated into the Jason-1 and Jason-2 satellites. The Jason-1 satellite was launched in December 2001, and is now providing Global sea surface topography measurement data to the international scientific community. This data is used by NOAA to support its research needs as well as to distribute information to satisfy user needs.

Starting with the launch of the Jason-2 satellite in June 2008, the Global sea surface topography mission will evolve to an operational mission with the addition of the NPGS capabilities. With the addition of the NPGS to the OSTM, many of the difficulties experienced with the current ground segment will be overcome and reliable and timely operational data will be provided to users.

2.2 NOAA's Current Polar Ground Segment

In support of the overall architecture planned for the NOAA Information Service Enterprise, NESDIS will continue to provide services and capabilities to meet the current polar mission. These services include monitoring sensor outputs, observing environmental events, and providing environmental data stewardship, as well as operating the satellites for monitoring and observing. The NPGS performs these heritage services and capabilities through an existing infrastructure consisting of the Satellite Operations Control Center (SOCC) and Command and Data Acquisition (CDA) stations, ESPC, the AAS functions within CLASS, and Communications. This same infrastructure and services will need to evolve to support the OSTM/Jason-2.

Command for POES satellites is conducted from the SOCC, through communications links with the ground segment facilities at the CDA stations. State of health and environmental data are routed to the SOCC and ESPC via communications links. Commanding and data acquisition are performed when the orbiting satellites are within line of sight of the CDA station's command transmitting and data receiving antennas. The communication links between polar ground segment facilities are illustrated in Figure 2.2. Polar orbiting satellite operations are conducted using the Polar Acquisition and Control Subsystem (PACS). PACS is a computer based real-time command and control system. Satellite operators conduct commanding and data acquisition by using an automated schedule running on PACS. The capability for operator manual intervention exists and is used when circumstances dictate. Part of the schedule driven system is the Command Level Schedule. It is used to configure the CDA and SOCC ground equipment in consonance with spacecraft activities.

The ESPC and AAS are currently being updated to support polar satellite programs out through 2030. Starting in 2006, ESPC will be providing support to the Initial Joint Polar Satellite Program, being conducted jointly with EUMETSAT. In addition, ESPC will incorporate and support the NPOESS data processing central and the NPOESS data exploitation efforts with operations starting in the 2008 time period. All of NOAA's future archive and access capabilities have been grouped into the Comprehensive Large Array-Data Stewardship System (CLASS) Program. All NPGS elements are connected by NOAA data and communications infrastructure with appropriate security provisions to be certified for operation under the NOAA security standards.

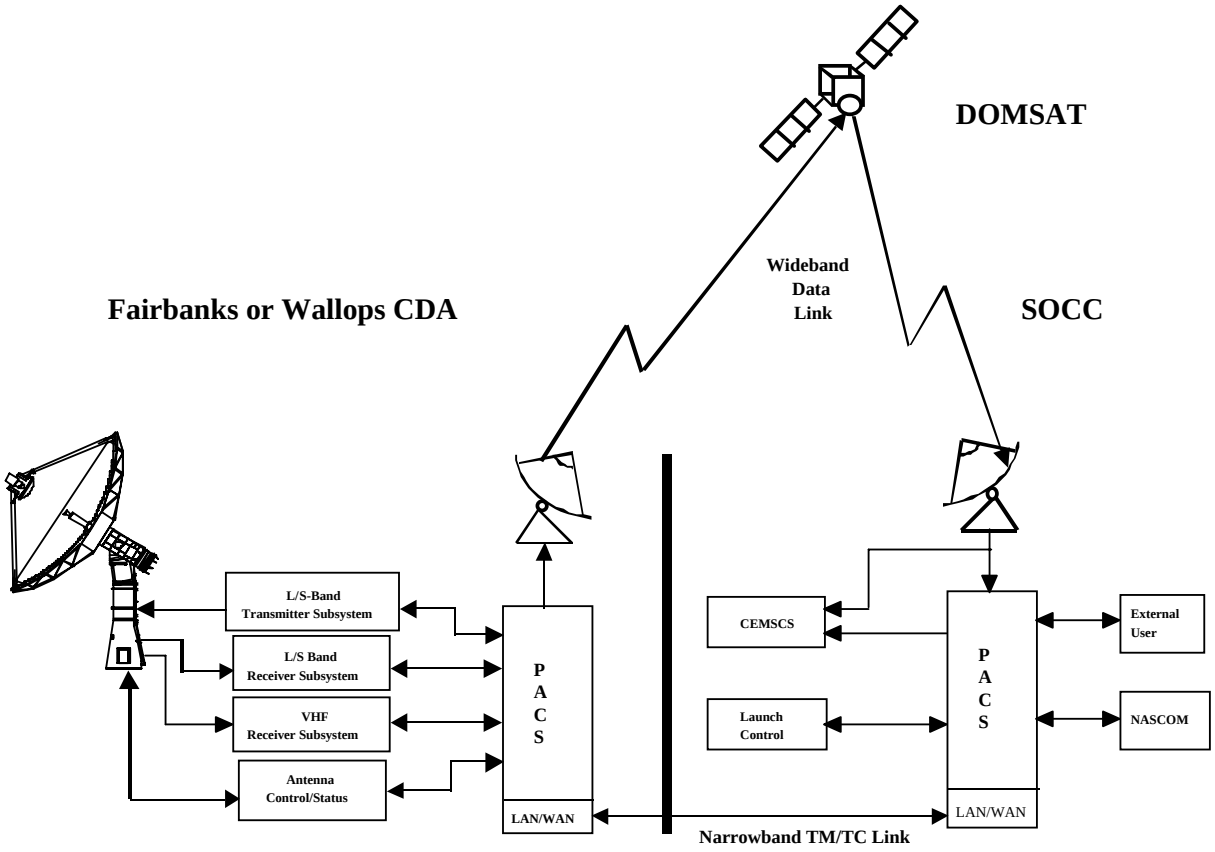

Figure 2.2 NOAA Communications Links

2.3 NOAA's Ground Segment Architecture for OSTM

For OSTM, NESDIS will use its infrastructure augmented by EUMETSAT's European Earth Terminal (EET) to provide services to monitor and control the Jason-2 satellite, process payload science data to generate near real-time products, and to steward OSTM data and products to support OSTM partners and NOAA users. NESDIS' capabilities required to ensure availability of the satellite data include program management, mission planning and scheduling, day-to-day operations, maintenance, sustaining activities, and engineering. These capabilities will be provided primarily from the SOCC and ESPC. Stewarding of the data encompasses data collection, monitoring of observing program performance, generating long-term records related to product development, data quality control, data and information distribution and access, and long-term permanent archiving. These capabilities will be provided primarily from the AAS within NOAA's CLASS. The NOAA Data Archive Board will consider all new requests for support for archive and access functions and provide the approved support from CLASS at assigned NOAA Data Centers.

Figure 2.3 contains a view of OSTM ground system functions and data flows. The diagram provides comprehensive view that includes functions that may be assigned to NASA/JPL, CNES,

and EUMETSAT. The two-digit numbers in the lower right of each block (i.e. 6.x) reference the source section in the document *OSTM/Jason-2 Ground System Requirements, Architecture and Operations Concepts* [AD-2].

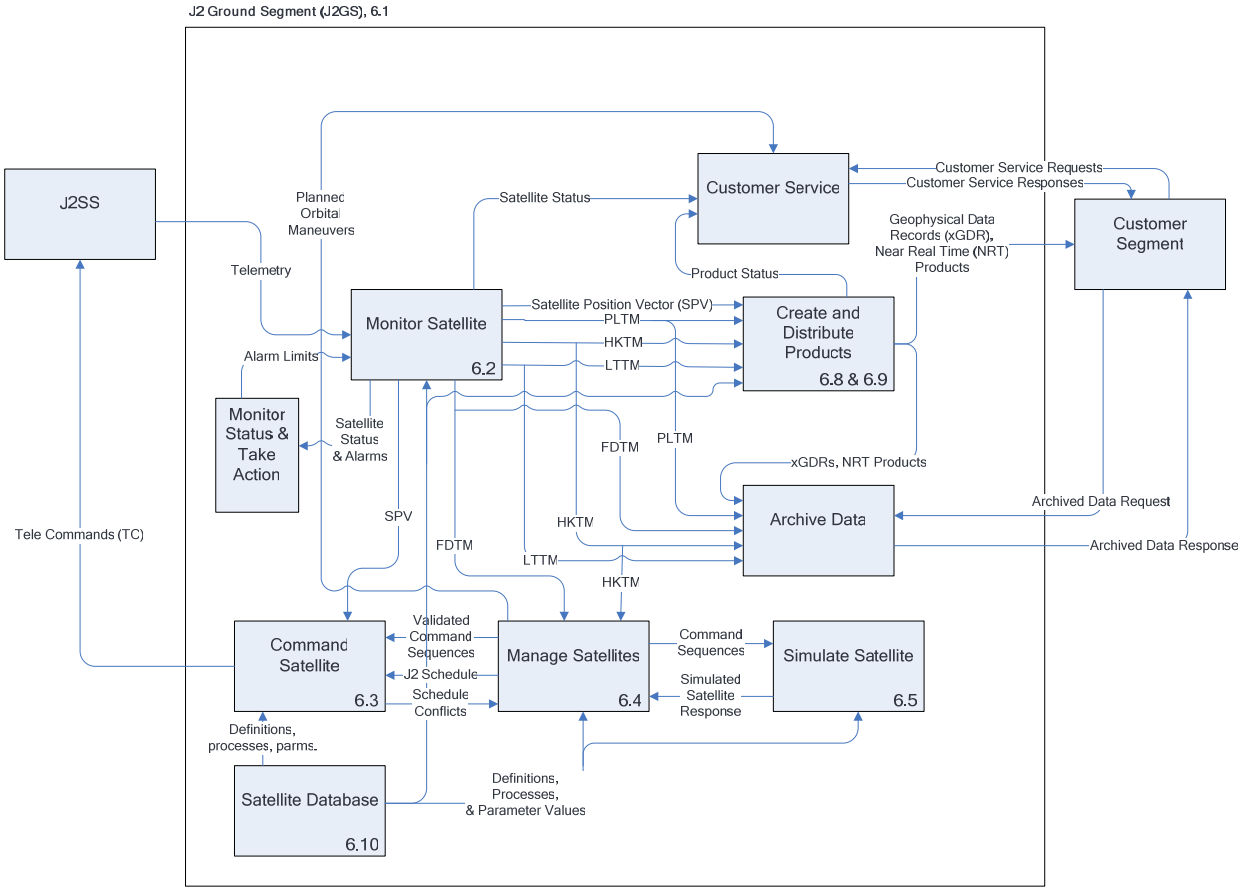

Figure 2.3 NOAA OSTM Ground Segment Planning Architecture

NPGS represents the functions allocated to the NOAA polar ground system that are needed to support OSTM.

The new requirements introduced by this document represent additions and/or modification to the existing NPGS requirements due to NOAA's participation in the OSTM operation and end-to-end services. New requirements include providing capability for satellite commanding and data acquisition for the Jason-2 satellite. NPGS will continue to work with existing contact scheduling capabilities. The NPGS will also control the operation of the EUMETSAT provided earth terminal during routine satellite operations, and processing of the payload science data to create and distribute Near Real-Time (NRT) data products (NRTDP). NRTDP are also known as Operational Geophysical Data Records (OGDRs). The NPGS will retrieve science Geophysical Data Records (GDRs) from CNES for NOAA users. All data will be archived by NOAA within CLASS to support OSTM users.

3 NPGS Upgrade Requirements to Support the OSTM

This section presents the requirements levied on the NPGS to support the OSTM. The NPGS requirements specified here apply to this upgrade. Existing requirements in place for the current operational NPGS shall be continued in the OSTM period without any interruption.

3.1 NPGS Functional Groups, Notations, and Requirements

Four major function groups used by NPGS to support OSTM are as follows: to provide operations control of the Jason-2 satellite, to provide payload science data processing, to provide archive and access of mission data and products, and to provide data communications. The NPGS requirements are associated with these functions in the requirement functional allocation area following each requirement [Function Allocation]. The four function groups use the following notation: Command and Control (C2), Data Processing (DP), Data Communications Network (DCN), and Archive and Access Services (AAS). Table 3-1 shows the mapping of functions to existing NPGS elements:

Table 3-1. Mapping of NPGS Functions to Existing NPGS Elements

Function	NPGS Element
C2	CDAS
	EET (developed by EUMETSAT and used by NPGS)
	SOCC
DP	ESPC
DCN	NESDIS Infrastructure
AAS	CLASS

Control of the Jason-2 satellite may be implemented through the use and integration of the NASA/JPL provided Jason Telemetry, Command and Communications Subsystem (JTCCS) used with the Jason-1 satellite along with existing NPGS hardware and software systems. Payload science data processing of the OSTM may be implemented through the use and integration of the CNES provided Near Real-Time Data Processing System (NRTDPS, also known as JSDS) for the Jason-2 satellite, to be located within ESPC. New archive and access functions will be implemented through CLASS as approved by the Data Archive Board (DAB).

Requirements applicable to the areas of Quality Control Standards, Maintainability, Training and Logistics are not specifically mentioned in this document based on the understanding that each element of the Polar Ground Segment is an operational entity and hence shall adopt their existing practice in these areas.

Requirements are presented in delineated paragraphs of text that include the following:

- Requirements identifier (ID) – a numerical identifier for each requirement
- Text paragraph – identifies the required capability or performance; may provide definitions or explanatory text
- Preliminary function allocation – preliminary allocation to one of the four major NPGS functions
- Requirements source link – reference link to the requirements source document
- Requirement Categorization – Categorizes each requirement into one of the following categories:
    - Existing Capability – Not changed with this OSTM upgrade (**EC-NCH**)
    - Existing Capability – May change with this OSTM upgrade (**EC-UPG**)
    - New Capability – Supplied by NOAA as GFE (e.g. JTCCS, JSDS) (**NC-GFE**)
    - New Capability – Acquired during this OSTM upgrade, but not supplied by NOAA (**NC-ACQ**)

The format for requirements identification is as follows:

Requirement Identifier (ID)	
Text Paragraph	**[Function Allocation]; [Requirement Source]; [Requirement Categorization];**

The **Requirement ID** is defined as follows:

For **NOAA Polar Ground Segment Requirements**, the requirement ID is in the form:

NPGS, <a.b.c.d.>-<number>", followed by text paragraph(s)

where,

<**a.b.c.d.**> corresponds to the subsection number in which the requirement is contained
<**number**> is a sequential number for the requirement.

The following describe other terminology/definitions that are used in this document:

- TBC - to be confirmed: Open issue, exact value/quantity/implementation yet to be decided
- TBD - to be determined: Open issue, under discussion
- TBS - to be supplied: Open issue, under analysis
- TBW - to be written: document under development

3.1.1 General

NPGS-3.1.1-010

Incorporating requirements into the NPGS to support the OSTM system shall not impact the ground segment's ability to meet existing Polar-orbiting Operational Environmental Satellite (POES) system requirements. [C2, DP, AAS, DCN]; [NOAA]; [EC-NCH];

NPGS-3.1.1-020

The NPGS shall support real time mission operations during the in-orbit Assessment and Verification phases as requested by other Parties. [C2, DCN]; [AD-1]; [NC-GFE];

NPGS-3.1.1-030

The NPGS shall be the primary location for operating and controlling the Jason-2 satellite during the Routine operation phase. [C2, DP, DCN, AAS]; [MOU, AD-2]; [NC-GFE];

NPGS-3.1.1-040

NPGS data and file interfaces shall comply with the requirements and descriptions in AD-4 (OSTM/Jason2 Ground System Interfaces). [C2, DP]; [MOU, AD-2/6.1-002]; [NC-ACQ]

NPGS-3.1.1-050

The NPGS shall be capable of remotely configuring and controlling the European Earth Terminal (EET) during the Routine operation phase. [C2, DCN]; [MOU, NPGS-3.1.13-001]; [NC-GFE];

NPGS-3.1.1-060

The NPGS shall be capable of commanding, controlling, and receiving telemetry from the Jason-2 satellite while the satellite is in view of the European Earth Terminal (EET). [C2]; [MOU, AD-2]; [NC-GFE];

NPGS-3.1.1-070

During the Routine Operational Phase, the NPGS shall retrieve the Jason-2 raw satellite telemetry data collected at the EET. [C2, DCN]; [MOU, AD-1, AD-2/6.1-002]; [NC-ACQ];

NPGS-3.1.1-080

The NPGS shall retrieve the near real time data products processed by EUMETSAT. [DP, DCN]; [MOU, AD-1, AD-2/6.1-002]; [NC-ACQ];

NPGS-3.1.1-090

The NPGS shall provide operational support 24-hours-a-day, seven-days-a-week. [C2, DP, DCN]; [AD-2/6.1-008]; [EC-NCH];

NPGS-3.1.1-100

The NPGS shall comply with NOAA security regulations. [C2, DP, AAS, DCN]; [AD-2/6.1-003, -005, -014, AD-5]; [EC-UPG];

NPGS-3.1.1-110

NPGS shall be capable of performing loop tests to detect and isolate RF, data, and tracking problems and failures. [C2]; [AD-2/6.1-006]; [EC-UPG]; A loop test (or "self-test") is a test that uses a feedback link to detect and locate faults.

NPGS-3.1.1-120

NPGS shall produce data recovery and quality statistics using GFE. [C2, DP, DCN]; [AD-2/6.1-007]; [NC-GFE];

NPGS-3.1.1-130

NPGS shall make available housekeeping and science data to designated Users (i.e., CNES, NASA and others). [C2, DP]; [AD-2/6.1-009]; [NC-ACQ];

NPGS-3.1.1-140

NPGS shall be capable of acquiring auxiliary data from external entities to support data processing needs. The auxiliary data for data processing is defined in the NASA/JPL Data Management Plan. [DP, DCN]; [AD-2/6.1-010]; [EC-UPG];

NPGS-3.1.1-150

NPGS shall be capable of acquiring auxiliary data from external entities to support mission planning. Auxiliary for mission planning includes Orbit Event Files, Pass Plans, Approved Sequence Requests, Telecommand Group (TC_GROUP), Command Block Calls, and Command Mneumonic Files. [C2, DCN]; [AD-2/6.1-010]; [EC-UPG];

NPGS-3.1.1-160

The NPGS shall be able to communicate with command, control and data processing centers at Partner facilities via the EUMETSAT interface. [C2]; [AD-2/3.1-011]; [NC-GFE];

NPGS-3.1.1-170

During the routine operation phase, the NPGS' contribution to the loss of all possible over-ocean data in a 12 month period for NRT data products shall be less than 2%. [C2, DCN]; [AD-2/6.1-013]; [NC-ACQ];

NPGS-3.1.1-180

The NPGS Wallops CDAS shall serve as SOCC backup for command and control functions. [C2]; [NOAA OSO]; [EC-UPG];

NPGS-3.1.1-190

The NPGS Wallops CDAS shall receive telemetry from EET via EUMETSAT and the Fairbanks CDA (FCDA) to support its SOCC backup function. [C2]; [NOAA OSO]; [EC-UPG];

3.1.2 Satellite Telemetry Monitoring

Satellite telemetry is divided into five main flows:

- Raw Telemetry flow: Frame data from the satellite downlink CCSDS/Virtual Channels.
- Real-Time Housekeeping (HKTM-P) flow: Contains minimum information on the instantaneous status and configuration of the satellite in packets sent with pre-defined

telemetry frequencies based on the modes of the satellite. These association of pre-define telemetry frequencies and satellite modes can not be modified once in flight.

- Recorded Housekeeping (HKTM-R) flow: Contains both long-term telemetry (LTTM) and failure diagnostic telemetry (FDTM). The LTTM contains the history of the satellite for long term analysis and some programmable "zooms" on particular events. The FDTM gives an accurate record of telemetry over a short period preceding a platform failure leading to a safe mode. Both are provided in telemetry packets sent with pre-defined telemetry frequencies based on the modes of the satellite. With the LTTM, the telemetry packets are recorded with pre-defined telemetry frequencies synchronously, which depend on the satellite modes. These frequencies can be modified by telecommands and telemetry packets generated and recorded asynchronously. With the FDTM, these pre-define frequencies depended on the satellite modes and can not be modified once in flight.
- Operational Science Data (PLTM-1) flow: Contains information transmitted from the payload used for the generation of the Operational Geophysical Data Record (OGDR).

3.1.2.1 Recorded Telemetry Processing

NPGS-3.1.2.1-010

The NPGS shall be capable of monitoring the performance of the satellite through the satellite's telemetry data. [C2]; [AD-2/6.2.1-001, AD-3]; [EC-UPG];

NPGS-3.1.2.1-020

The NPGS shall receive all HKTM-R telemetry data from the Jason-2 Space Segment. [C2]; [AD-2/6.2.1-002, AD-3]; [NC-GFE];

NPGS-3.1.2.1-030

The NPGS shall receive all PLTM telemetry data from the Jason-2 Space Segment. [C2]; [AD-2/6.2.1-003, AD-3]; [NC-GFE];

NPGS-3.1.2.1-040

The NPGS shall produce raw telemetry files containing selected housekeeping packet types. [C2]; [AD-2/6.2.1-004, AD-3]; [NC-GFE];

NPGS-3.1.2.1-050

The NPGS shall produce raw telemetry files containing selected science data packet types. [C2, DP]; [AD-2/6.2.1-004, AD-3]; [NC-GFE];

NPGS-3.1.2.1-060

NPGS shall use parameters in the SDB to process the TM extracted packets (e.g. coding, transfer functions, significance conditions, control conditions, calculated parameters operations) to get engineering parameters. [C2, DP]; [AD-2/6.2.1-005, 6.2.1-006, AD-3]; [NC-GFE];

NPGS-3.1.2.1-070

NPGS shall determine the quality (number of lost frames or percentage of dumped TM received) of the received recorded telemetry to have to re-dump if necessary the HKTM-R and/or the PLTM data. [C2, DP]; [AD-2/6.2.1-007, AD-3]; [NC-GFE];

NPGS-3.1.2.1-080

The NPGS shall process HKTM-R, display data values, and log alarm conditions. [C2]; [AD-2/6.2.1-008, AD-2/3.13-002, AD-3]; [NC-GFE];

NPGS-3.1.2.1-090

NPGS shall be capable of processing one pass (i.e. applying all SDB functions – decommutation, transfer function, engineering values, alarm limits, etc.) of HKTM-R to support operator review in less than 10 minutes. [C2]; [AD-2/6.2.1-008, AD-3]; [NC-GFE];

NPGS-3.1.2.1-100

The NPGS shall store the HKTM-R telemetry data on-line at least for 30 days. [C2]; [AD-2/6.2.1-002, 0010, AD-3]; [EC-UPG]

3.1.2.2 Real Time Telemetry Processing

NPGS-3.1.2.2-010

The NPGS shall monitor the satellite bus and instruments health and safety during each scheduled station pass during the routine operation and extended operation phases. [C2]; [AD-2/6.2.2-001, AD-3]; [NC-GFE];

NPGS-3.1.2.2-020

The NPGS shall receive the HKTM-P telemetry data from Jason-2 from each scheduled station pass. [C2]; [AD-2/6.2.2-002, AD-3]; [NC-GFE];

NPGS-3.1.2.2-030

The NPGS shall be able to process the HKTM-P telemetry in real time by applying the logic described in the SDB (extraction, coding, transfer function, significance condition, alarm limits, calculated parameters operations) except for the Dump packets. [C2]; [AD-2/6.2.2-003, AD-3]; [NC-GFE];

NPGS-3.1.2.2-040

The NPGS shall be capable of processing each HKTM-P packet in one second or less. [C2]; [AD-2/6.2.2-003, AD-3]; [NC-GFE];

NPGS-3.1.2.2-050

NPGS shall display satellite HKTM-P telemetry data in real-time during all satellite contacts. [C2]; [AD-2/6.2.2-004, AD-3]; [NC-GFE];

NPGS-3.1.2.2-060

The NPGS shall retain the complete HKTM-P telemetry until the corresponding HKTM-R is successfully recorded on the ground. [C2]; [AD-2/6.2.2-005, AD-3]; [NC-ACQ];

NPGS-3.1.2.2-070

The NPGS shall be able to inhibit, restore and change alarm limits in real time. [C2]; [AD-2/6.2.2-006, AD-3]; [NC-GFE];

3.1.2.3 Analysis Telemetry Processing

NPGS-3.1.2.3-010

The NPGS shall be capable of re-processing HKTM pass (in the same way as in real-time) both from the archived HKTM-R telemetry and from the HKTM-P telemetry. [C2]; [AD-2/6.2.3-001, AD-3]; [NC-GFE];

NPGS-3.1.2.3-020

The NPGS shall be able to extract and process data files from HKTM-R telemetry using the criteria of date and application processor identifier (APID). [C2]; [AD-2/6.2.3-003, AD-3]; [NC-GFE];

NPGS-3.1.2.3-030

The HK telemetry archive access shall be secure in accordance with NOAA standards. [AAS]; [AD-2/6.2.3-004, AD-3, and AD-5]; [EC-UPG];

NPGS-3.1.2.3-040

NPGS shall maintain a ground image of the onboard computer memory, update it as memory load commands are transmitted to the satellite, and compare it with onboard computer memory dumps. [C2]; [AD-2/6.2.3-006, AD-3, and AD-5]; [NC-GFE]

3.1.2.4 Telemetry Information Display

NPGS-3.1.2.4-010

The NPGS shall display in color the parameters described in the satellite database with their status during normal operations or during satellite warning conditions, changes in operational state, error conditions, or fatal conditions that potentially could aversely affect the ability to continue the mission. [C2]; [AD-2/6.2.4-001, AD-3]; [NC-GFE];

NPGS-3.1.2.4-020
The NPGS shall display the evolution of the parameters (e.g. curves, value vs. time, or value vs. value). [C2]; [AD-2/6.2.4-002, AD-3]; [NC-GFE];

NPGS-3.1.2.4-030
The NPGS shall be able to display raw value, physical value, and characteristics of any parameter of the satellite database. The raw values are Decimal Notation (DN) and binary values. Physical values are Engineering Unit (EU) converted for the analog channel or states associated with discrete channels such as On, OFF etc. Characteristics of parameters are the static data associated with the channel specified in SDB. Typical examples include polynomial coefficients associated with converting DN values to EU values, alarm limits, channel description, etc. [C2]; [AD-2/6.2.4-003, AD-3]; [NC-GFE];

3.1.3 Satellite Commanding

The Jason satellite will be controlled by commands transmitted from the ground to the spacecraft and instrument payload via the NOAA command and data acquisitions stations and the EUMETSAT Earth Terminal, under control of the NPGS.

The uplink flow is divided into the following main flows:

Commands not processed by the on-board computer:

- TCD commands: priority commands to change the satellite's configuration status,

Commands processed by the on-board computer:

- For the spacecraft platform
  - TC OBDH containing an OBDH message
  - TC OBS for a more complex execution
- For the instrument payload
  - TCU 1553 containing a 1553 message
  - TCU OBS for a more complex execution by OBS

Each command processed by the on-board computer can be "immediate" to execute changes immediately or "time tagged" to be executed on-board by the OBS at a given date relative to on-board time.

3.1.3.1 Command Processing

NPGS-3.1.3.1-010

The NPGS shall be capable of receiving satellite command lists from partners in support of mission planning activities. [C2]; [MOU, AD-2/6.3.1-001, AD-2/6.13-002, AD-3]; [NC-ACQ];

NPGS-3.1.3.1-020

The NPGS shall be capable of preparing, validating and transmitting commands to the satellite. [C2]; [AD-2/6.3.1-002, AD-3]; [NC-GFE];

NPGS-3.1.3.1-030

The NPGS shall format satellite commands into packets according to Jason-2 Satellite-to-Ground Interface [AD-3]. [C2]; [MOU, AD-3]; [NC-GFE];

NPGS-3.1.3.1-040

The NPGS shall be capable of compiling time ordered lists of all commands. This refers to sequencing commands into the proper order. [C2]; [AD-2/6.3.1-004 AD-3]; [NC-ACQ];

NPGS-3.1.3.1-050

The NPGS shall be capable of executing nominal procedures for Routine mission operations. Nominal procedures are pre-prepared command files. [C2]; [AD-2/6.3.1-005, AD-3]; [NC-GFE];

NPGS-3.1.3.1-060

The NPGS shall implement a command restriction capability such that potentially catastrophic commands require a special operator action to be sent. Potentially catastrophic commands will be removed from the SDB. If a potentially catastrophic command is needed, it will be temporarily added to the SDB. [C2]; [AD-2/6.3.1-006, AD-3]; [NC-GFE];

NPGS-3.1.3.1-070

The NPGS shall have the capability to execute pre-prepared command procedures and files for satellite failure recovery events. These procedures and files are to be readily available for up-link. [C2]; [AD-2/3.3.1-005, AD-2/3.3.1-007, AD-3]; [NC-GFE];

3.1.3.2 Command Generation

NPGS-3.1.3.2-010

The NPGS shall prepare and make available commands to designated earth terminals prior to the opening of the local satellite acquisition window. [C2]; [AD-2/6.3.2-001, AD-3]; [EC-UPG];

NPGS-3.1.3.2-020

The NPGS shall be capable of validating that prepared command plans can be nominally uploaded to the satellite on the next pass. [C2]; [AD-2/6.3.2-002, AD-3]; [EC-UPG]

NPGS-3.1.3.2-030

The NPGS shall use the satellite database for translating commands to generate TC packets. [C2]; [AD-2/6.3.2-003, AD-3]; [NC-GFE];

NPGS-3.1.3.2-040
The NPGS shall check coherency between commands uploads (TCs) and satellite database description. This involves validating commands using the satellite database. [C2]; [AD-2/6.3.2-004, AD-3]; [NC-GFE];

NPGS-3.1.3.2-050
The NPGS shall protect against modifications to the command generation process not introduced through approved operator action. [C2]; [AD-2/6.3.2-005, AD-3]; [NC-GFE];

3.1.3.3 Command Sequencing

NPGS-3.1.3.3-010

The NPGS shall generate satellite command sequences one per week, daily or as needed, that include:

a) Sequence of Events specifying detailed satellite events and event times in UTC,
b) Graphical Timeline summarizing the satellite events for each day,
c) Command file containing the set of time tagged commands to be loaded into the satellite to cover the sequence period, and
d) Command files containing immediate execute commands in support of satellite-sequenced activities. [C2]; [AD-2/6.3.3-001, AD-3]; [NC-ACQ];

NPGS-3.1.3.3-020

The NPGS shall support mission planning to coordinate sequence requests, expand the requests into detailed sequence items, ensure that no conflicts exist between sequence requests, and ensure that no mission or satellite rules would be violated by the sequence. [C2]; [AD-2/6.3.3-002, AD-3]; [NC-ACQ];

NPGS-3.1.3.3-030

The NPGS shall generate and maintain a database containing standard sequence elements for use in generating and processing sequence requests. [C2]; [AD-2/6.3.3-003, AD-3]; [NC-ACQ];

NPGS-3.1.3.3-040

The NPGS shall generate and maintain a list of mission and satellite rules and constraints. [C2]; [AD-2/6.3.3-004, AD-3]; [NC-ACQ];

NPGS-3.1.3.3-050

The NPGS Sequencer shall be capable of receiving and processing the LEO-T files from the existing NPGS scheduler. [C2]; [AD-2/6.3.3-004, AD-3]; [NC-ACQ];

NPGS-3.1.3.3-060

The NPGS Sequencer shall send the command file output to JTCCS and make it available to CNES for validation. [C2]; [AD-2/6.3.3-004, AD-3]; [NC-ACQ];

3.1.3.4 Scheduling

NPGS-3.1.3.4-010

The NPGS shall be able to schedule the SOCC, CDAS, and EUMETSAT EET equipment to support Jason-2 Routine and contingency operations once per week, daily or as needed that includes:

a) detailed ground segment events and event times in UTC
b) Graphical Timeline summarizing the ground segment events for each day. [C2]; [NOAA]; [EC-UPG];

3.1.3.5 Real Time Telecommand (TC) Transmission

NPGS-3.1.3.5-010

The NPGS shall provide the capability to stop the command transmission through operator intervention for command lists greater than one command. [C2]; [AD-2/6.3.4-001, AD-3]; [EC-UPG];

NPGS-3.1.3.5-020

The NPGS shall have the capability to send command transmissions in either the “step-by-step” or “burst” mode. The term “burst mode” is equivalent to the term “run mode.” [C2]; [AD-2/6.3.4-002, AD-2/3.13-001, AD-3]; [NC-GFE];

NPGS-3.1.3.5-030

The NPGS shall have the capability to maintain specified command order during command transmission. [C2]; [AD-2/6.3.4-003, AD-3]; [EC-UPG];

NPGS-3.1.3.5-040

The NPGS shall have the capability to implement specified command timing requirements as specified in AD-3. [C2]; [AD-2/6.3.4-004, AD-3]; [EC-UPG];

NPGS-3.1.3.5-050

The NPGS shall verify the sending conditions are fulfilled to send a command. [C2]; [AD-2/6.3.4-005, AD-3]; [EC-UPG];

NPGS-3.1.3.5-060

The NPGS shall verify that the command structure and key parameters (e.g. time, telemetry point values) are correct prior to command transmission. [C2]; [AD-2/6.3.4-005, AD-3]; [NC-GFE];

NPGS-3.1.3.5-070

The NPGS shall have the capability to manage the time tagged buffer to avoid loss of the mission commands. [C2]; [AD-2/6.3.4-006, AD-3]; [NC-GFE];

NPGS-3.1.3.5-080

The NPGS transmission and re-transmission of uplink commands shall be managed by the Command Operation Procedure (COP-1) protocol. [C2]; [AD-2/6.3.4-007, AD-3]; [NC-GFE];

NPGS-3.1.3.5-090

The NPGS shall be able to control the COP-1 protocol parameters. [C2]; [AD-2/6.3.4-008, AD-3]; [NC-GFE];

NPGS-3.1.3.5-100

The NPGS shall have the selective control of the COP-1 to stop automatically the command transmission according to a specific directive included in the command file to be able to choose the next sending mode ("step by step or burst"). [C2]; [AD-2/6.3.4-009, AD-3]; [Our understanding: CP suspend command]; [NC-GFE];

3.1.3.6 Command Information Display

NPGS-3.1.3.6-010

The NPGS shall be capable of displaying all the commands described in the SDB with their features. [C2]; [AD-2/6.3.5-001]; [NC-GFE];

NPGS-3.1.3.6-020

The NPGS shall display in real-time the command transmission events. [C2]; [AD-2/6.3.5-002]; [NC-GFE];

NPGS-3.1.3.6-030

The NPGS shall be able to display in real-time the sequence of commands or command files as they are transmitted. [C2]; [AD-2/6.3.5-003]; [NC-GFE];

3.1.4 Satellite Management

NPGS-3.1.4-010

The NPGS shall perform satellite monitoring and control functions in support of Jason-2 satellite management procedures. Management procedures are derived from CNES. [C2]; [MOU, AD-2/6.4-001 through -008, AD-3]; [NC-GFE];

NPGS-3.1.4-020

The NPGS shall perform resource scheduling and prioritization in support of the Jason-2 satellite management procedures. [C2]; [MOU, AD-2/6.4-001 through -008, AD-3]; [EC-UPG];

3.1.5 Satellite Simulator

NPGS-3.1.5-010

The NPGS shall be capable of conducting interface test sequences using the Jason satellite simulator (PRESTO). [C2]; [AD-2/6.5-001, AD-3]; [NC-GFE];

3.1.6 Navigation Support

In planning for support of OSTM on-orbit navigation adjustments, the following mission planning constraints will be followed:

- Maneuvers are planned to be performed at the 10 day cycle boundaries, and
- Maneuvers are planned to be performed over land as much as possible to avoid loss of ocean science data.

NPGS-3.1.6-010

The NPGS shall calculate the satellite ground station view periods and all the parameters associated each station pass. [C2]; [AD-2/6.6-006, AD-3]; [EC-UPG];

NPGS-3.1.6-020

The NPGS shall be capable of canceling a planned maneuver with a notice of TBD hours and to implement an alternative maneuver as directed. [C2]; [AD-2/6.6-011, AD-3]; [EC-UPG];

3.1.7 Time Usage

NPGS-3.1.7-010

All time used in the NPGS interfaces shall be in Universal Time Coordinated (UTC). [C2, DP]; [AD-2/6.7-001, AD-3]; [EC-NCH];

NPGS-3.1.7-020

Time used in the NPGS interfaces and operator displays shall be specified using the following formats:

- The standard time format for operator input and display shall be ASCII Time: "YYYY/MM/DD HH:MM:SS" OR "YYYY-DDDTHH:MM:SS."
- The standard time format in files shall be ASCII Time: "YYYY/MM/DD HH:MM:SS.sss" or "YYYY-DDDTHH-MM:SS.sss."
- The standard time format in binary interface files shall be 10 bytes: the binary GPS on-board format. [C2, DP]; [AD-2/6.7-002, AD-3, AD-11/5.1.1, AD-11/5.2.1]; [EC-UPG];

NPGS-3.1.7-030

The NPGS shall add UTC time tags to all satellite telemetry data generated without UTC time tags or false UTC time tags. [C2]; [AD-2/6.7-003, AD-3]; [EC-UPG];

NPGS-3.1.7-040

The NPGS shall use a standard set of time conversion routines. This capability was developed for Jason-1 by CNES and JPL and will be used for Jason-2. [C2, DP]; [AD-2/6.7-005, AD-3]; [NC-GFE];

NPGS-3.1.7-050

The NPGS shall give the date of the packet to all the parameters inside the packet in the satellite's normal mode. Each packet contains one GPS date in the secondary header. In the field "data" each packet contains TM parameters. The control center attributes to each parameter included in a packet the date of the packet. [C2]; [AD-2/6.7-006, AD-3]; [NC-GFE,;

NPGS-3.1.7-060

The NPGS shall generate a date and time for archiving the telemetry packets when the satellite is in safe-hold mode. [C2]; [AD-2/6.7-007, AD-3]; [NC-GFE];

NPGS-3.1.7-070

The NPGS shall compute an offset between the On-Board Time and the UTC. This offset will be used to generate telecommands to the satellite and to complete requirements NPGS-3.1.7-030 and NPGS-3.1.7-070. [C2]; [AD-2/6.7-008, AD-3]; [NC-GFE];

3.1.8 Product Processing

NPGS-3.1.8-010

The NPGS shall generate Near Real-Time (NRT) Products using the GFE Data Processing System. [DP]; [AD-2/6.8-003, AD-1]; [NC-GFE];

NPGS-3.1.8-020

The NPGS shall be capable of assessing the quality of the NRT product generated by NOAA and EUMETSAT to support verification of accuracy. [DP]; [AD-2/6.8-006, AD-1]; [NC-GFE];

NPGS-3.1.8-030

The NPGS shall provide data accountability statistics with each telemetry data product. [DP]; [AD-2/6.8-013, AD-1]; [EC-UPG];

NPGS-3.1.8-040

The NPGS shall use a table of mathematical, physical, and astronomical constants as recommended by the Science Working Team. [DP]; [AD-2/6.8-014, AD-1]; [EC-UPG];

3.1.9 Archive, Access and Distribution

NPGS-3.1.9-010

The NPGS shall archive NOAA-generated NRT products. [DP, AAS]; [AD-2/6.9-001, AD-1]; [EC-UPG];

NPGS-3.1.9-020

The NPGS shall archive raw telemetry data from the satellite. [C2, DP, AAS]; [MOU, AD-1]; [EC-UPG];

NPGS-3.1.9-030

The NPGS shall archive the NRT data products received from EUMETSAT. [DP, DCN, AAS]; [NPGS-3.1.1-070, AD-1]; [EC-UPG];

NPGS-3.1.9-040

The NPGS shall archive the Science Data products received from CNES. [DP, DCN, AAS]; [MOU, AD-2/6.9-002/ AD-1]; [EC-UPG];

NPGS-3.1.9-050

The NPGS shall archive all data necessary to recreate products. [DP, AAS]; [AD-2/6.8-008, AD-1]; [EC-UPG];

NPGS-3.1.9-060

The NPGS shall archive all received HKTM-R telemetry data for a minimum of 10 years. [C2, AAS]; [AD-2/6.2.1-002, 011, AD-3]; [EC-UPG];

NPGS-3.1.9-070

The NPGS shall archive all received PLTM (science) telemetry data for a minimum of 20 years. [DP, AAS]; [AD-2/6.2.1-003, 012, AD-3]; [EC-UPG];

NPGS-3.1.9-080

The NPGS shall be capable of archiving all commands sent to Jason-2. [C2, AAS]; [AD-2/6.3.1-004, AD-3]; [NC-GFE];

NPGS-3.1.9-090

The NPGS shall archive the orbital parameters required for orbital control maneuvers. [AAS]; [AD-2/6.6-005, AD-3]; [NC-GFE];

3.1.10 Product Distribution

NPGS-3.1.10-010

The NPGS shall make available 75% of the NRT products within 3 hours of acquisition at the spacecraft and 100% of the NRT products within 5 hours. [DP, DCN]; [AD-2/6.8-005, AD-1]; [NC-ACQ];

NPGS-3.1.10-020

The NPGS shall make available to NOAA users the Science Data products received from CNES. [DP]; [MOU, AD-2/6.9-004/ AD-1]; [NC-ACQ];

NPGS-3.1.10-030

The NPGS shall make available to NOAA users and Partners the NRT products received from Eumetsat. [DP, DCN]; [MOU, AD-2/6.8-004, 6.1-002, AD-1]; [NC-ACQ];

3.1.11 Data Communications Network (DCN)

NPGS-3.1.11-010

The NPGS shall be sized to support the acquisition of raw satellite data, and the availability of products (including NRT products) to users while satisfying NOAA's timeliness and performance requirements. [DCN]; [MOU, AD-2/6.11-001, AD-1]; [NC-ACQ];

NPGS-3.1.11-020

The NPGS shall have the capability to distribute products and ancillary information to NOAA's long term archive while satisfying NOAA's timeliness and performance requirements. [DCN]; [MOU, AD-2/6.11-001, AD-1]; [EC-UPG];

NPGS-3.1.11-030

The NPGS shall have the capability to receive raw telemetry and processed science product information from EUMETSAT, and CNES. [DCN]; [MOU, AD-2/6.11-001, AD-1]; [NC-ACQ];

NPGS-3.1.11-040

The NPGS shall be capable of identifying the location(s) of one or more DCN problems. [DCN]; [AD-2/6.11-002, AD-1]; [NC-ACQ];

NPGS-3.1.11-050

The NPGS shall support File Transfer Protocol (FTP) and Secure FTP (SFTP) and real-time packets in Transmission Control Protocol/Internet Protocol (TCP/IP). [DCN]; [AD-2/6.11-003, AD-1]; [NC-ACQ];

NPGS-3.1.11-060

The NPGS shall be implemented in accordance with NOAA's security requirements. [DCN]; [AD-2/6.11-004, AD-1]; [EC-UPG];

NPGS-3.1.11-070

The NPGS shall make available all the received data (PLTM, HKTM-P, and HKTM-R) to the end users at the interface point (ESPC, EUM) in 20 minutes or less after the completion of the satellite dump of the data at the NOAA CDAS. [DCN]; [AD-2/6.11-005, AD-1]; [NC-ACQ];

NPGS-3.1.11-080

The NPGS shall make available all the received data (PLTM, HKTM-P, and HKTM-R) to the end users at the interface point (ESPC, EUM) in 20 minutes or less after the data is received at the EUMETSAT interface point. [DCN]; [AD-2/6.11-003]; AD-1 [NC-ACQ];

NPGS-3.1.11-090

The NPGS shall make available Virtual Channel 0 (VC=0) (i.e. HKTM-P) transfer frames to the NOAA SOCC in real time via a dedicated socket connection initiated by the EET/CDAS. [DCN]; [AD-2/6.11-003]; AD-1 [NC-ACQ];

NPGS-3.1.11-100

The NPGS shall make available the complete set of VC=1 (i.e. PLTM) transfer frames that are received at the EET/CDAS from the Jason-2 satellite during a single pass to the NOAA SOCC within 15 minutes of loss of signal (LOS). [DCN]; [AD-2/6.11-003]; AD-1 [NC-ACQ];

NPGS-3.1.11-110

The NPGS shall make available VC=2 (i.e. PLTM-2) and VC=7 (i.e. HKTM-R) transfer frames that are received at the EET/CDAS from the Jason-2 satellite during a single pass to the NOAA SOCC immediately following the successful transfer of the VC=1 transfer frames. VC=2 has priority over VC=7. [DCN]; [AD-2/6.11-003]; AD-1 [NC-ACQ];

NPGS-3.1.11-120

The NPGS shall make available commands received from CNES at the Eumetsat interface point to the NOAA SOCC for preparation and upload to the satellite. [DCN]; [AD-2/6.3.1-002]; AD-1 [NC-ACQ];

NPGS-3.1.11-130

The NPGS shall make available Virtual Channel 0 (VC=0) (i.e. HKTM-P) transfer frames to the Wallops CDAS (WCDAS) backup capability in real time via a dedicated socket connection initiated by the EET/CDAS when WCDAS is the active control center. [DCN]; [OSO, AD-2/6.11-003]; AD-1 [NC-ACQ];

NPGS-3.1.11-140

The NPGS shall make available VC=2 (i.e. PLTM-2) and VC=7 (i.e. HKTM-R) transfer frames that are received at the EET/CDAS from the Jason-2 satellite during a single pass to the WCDAS backup capability immediately following the successful transfer of the VC=1 transfer frames when WCDAS is the active control center. VC=2 has priority over VC=7. [DCN]; [OSO, AD-2/6.11-003]; AD-1 [NC-ACQ];

NPGS-3.1.11-150

The NPGS shall make available commands received from CNES at the Eumetsat interface point to the WCDAS for backup capability. [DCN]; [OSO, AD-2/6.3.1-002]; AD-1 [NC-ACQ];

3.1.12 Earth Terminals

NPGS-3.1.12-010

The NPGS shall utilize and upgrade existing operational NOAA CDA stations at Wallops, Virginia and Fairbanks, Alaska. [C2]; [MOU]; [EC-UPG];

NPGS-3.1.12-020

The NPGS shall retain all received telemetry for a minimum of seven days at the CDA stations. [C2] [AD-2/6.12-005]; [EC-UPG];

NPGS-3.1.12-030

The NPGS shall have the capability to remotely control, operate and use the EET. [C2, DCN]; [MOU, NPGS-3.1.13-001]; [NC-GFE];

NPGS-3.1.12-040

The NPGS shall provide remote status from each CDA and EET to SOCC to identify the status of different elements of the earth terminal or CDA (diagnostics in case of failure). [C2]; [AD-2/6.12-002]; [EC-UPG];

3.1.13 Control Center

NPGS-3.1.13-010

The NPGS shall use existing Satellite Operations Control Center (SOCC), in Suitland Maryland, or the backup Control Center at Wallops, Virginia to meet command and control requirements specified in this document. [C2] [MOU, AD-2/6.13-001]; [EC-UPG];

NPGS-3.1.13-020

The NPGS shall have one and only one active control center that can send commands to the satellite at any given time. [C2] [AD-2/6.13-001]; [EC-NCH];

NPGS-3.1.13-030

NPGS shall be able to connect itself to the CNES control center to capture real-time HKTM-P telemetry. [C2, DCN] [AD-2/6.13-004]; [NC-GFE];

3.1.14 Performance Requirements

NPGS 3.1.14-010

The NPGS shall have an operational availability of 0.96 over 24 hours per day, 365 days per year. [C2, DCN]; [MOU]; [NC-ACQ];

NPGS 3.1.14-020

The NPGS shall separate each upload from the previous one by at least 250 milliseconds (instrument constraint). This delay will be managed by the ground segment. [C2]; [AD-3/2.1.3.3-001]; [EC-UPG];

3.1.15 Security Requirements

The NPGS Statement of Work (SOW) contains security requirements.

3.1.16 Software Acquisition and Development Requirements

These software development requirements supports the operations and maintenance of capabilities acquired and developed for OSTM.

NPGS 3.1.16-010

NPGS shall provide the capability to maintain system components in accordance with manufacturer guidelines. [C2, DP, AAS, DCN]; [AD-2/6.1-004]; [EC-UPG];

NPGS 3.1.16-020

NPGS shall provide the capability maintain a knowledge base, including processes, procedures, and documentation, to support sustainability. [C2, DP, AAS, DCN]; [AD-2/6.1-004]; [EC-UPG];

NPGS 3.1.16-030

NPGS shall have top-down design where subordinate functions are traceable to higher-level ones and to requirements. [C2, DP, AAS]; [AD-2/6.1-004]; [NC-ACQ];

NPGS 3.1.16-040

NPGS shall invoke algorithms as modules to reduce testing risk and have more effective deployment of skilled staff. [C2, DP]; [AD-2/6.1-004]; [NC-ACQ];

NPGS 3.1.16-050

NPGS shall share procedures among its subsystems to reduce redundancy. [C2, DP, AAS]; [AD-2/6.1-004]; [EC-UPG];

NPGS 3.1.16-060

NPGS shall employ standard information sharing technologies where applicable; examples include relational databases and data distribution standards. [C2, DP, AAS]; [AD-2/6.1-004]; [EC-UPG];

NPGS 3.1.16-070

NPGS shall employ standard software engineering methods. [C2, DP, AAS]; [AD-2/6.1-004]; [EC-NCH];

NPGS 3.1.16-080

NPGS shall employ software engineering tools. [C2, DP, AAS]; [AD-2/6.1-004]; [EC-NCH];

NPGS 3.1.16-090

NPGS shall employ configuration management. [C2, DP, AAS, DCN]; [AD-2/6.1-004]; [EC-NCH];

4 Requirements Verification and Validation (V&V)

4.1 Introduction

In support of the OSTM/Jason-2 project, NOAA and its partners will build, integrate, verify and validate their respective space and ground systems. NOAA and its contractor(s) will upgrade its operational NOAA Polar Ground Segment (NPGS). NOAA's National Environmental Satellite Data and Information Service (NESDIS) is the organization that is primarily responsible for managing the upgrade.

4.2 Scope

The scope of the NPGS V&V requirements apply to all activities to be performed in support of verifying and validating all requirements stated in Section 3 of this document, and joint testing among the Partners for the verification of external interfaces. The Contractor is responsible for the V&V requirements stated in the Statement of Work for this OSTM/Jason-2 contract.

The V&V activities (test planning, execution, reviews, documentation, etc.) are performed during the Pre-launch and Post-launch periods of the OSTM/Jason-2 Project. During Pre-launch, the requirements stated in Section 3 will be implemented either through existing Government capabilities or through targeted procurement/contract actions.

V&V will relate to the implementation of requirements of Section 3. V&V plans, procedures, and test reports, and system evaluations will be related and linked to requirements for qualification testing.

For the joint system V&V, the Government will coordinate the applicable tests to be performed with the OSTM Partners and V&V plans, procedures, reports and additional testing will provide support to the Government as needed.

4.3 General Requirements

The following general requirements (guiding principals) shall be common to all OSTM V&V activities.

- The overall V&V program will be conducted in "building block" methodology, such that each level of V&V progressively contributes to the overall system verification.

- Testing will be the preferred method of verification for all new system upgrades/ modifications and interfaces.

- New upgrades will not impact the existing operational systems. Regression testing will be used to verify existing systems continue to operate properly.

- Tests will be conducted as early as possible during the integration process and repeated later as necessary. The objective of successive tests should be to mitigate any projected risk factors.

- Verify stand-alone subsystems prior to integrating into a system.

- Test activities will be conducted in the actual operational environment. If it is not possible to do so due to complexity, cost, etc, the environment will be a very close simulation of the actual operational environment.

- All operational hardware and software will be tested at least once, simulating operational environment.

- The test data types, formats, rates and size will emulate actual operational conditions. Verify all types of spacecraft and instrument data that would be operationally processed by the system. The test data types should include real spacecraft and instrument data. Simulated test data and test tools may be used to supplement actual data.

- End-to-end (ETE) data flow test scenarios will be part of the V & V test activities to verify interfaces, and the overall ETE system performance of the integrated OSTM/Jason-2 system.

4.4 Joint System V&V

Joint System V&V activity, with Partners, will be coordinated by the Government for joint execution. The Contractor shall assist the Government in executing this activity (V&V planning, procedures, reporting and documentation, etc.)

This activity includes ETE OSTM/Jason-2 system functional and performance validation, including interfaces between all Partners' systems. Joint tests will validate that the Jason-2 system is operationally compatible between Partners, to receive and transmit all types of data. Joint testing will also verify that the satellite data can be shared between systems while satisfying product processing timeliness requirements. Selected nominal and contingency operational scenarios will be verified as to be defined in joint documents. The activities will establish the ETE system compliance with the Jason-2 functional requirements and validate operational performance parameters.

4.5 Verification Methods

Table 4-1 contains definitions of verification methods. Each requirement shall be mapped to one or more verification methods. Verification methods may depend on other verification methods in a "building-block" fashion, particularly for verifying groups of integrated hardware, software, or communications components. For example, an analysis may depend upon test results. System evaluation will utilize verification and test results to assess the systems effectiveness in meeting the mission objectives.

Table 4-1. Verification Methods

Verification Method	Definition
ANALYSIS	Analysis is an engineering assessment and/or mathematical process that may include computer modeling and/or simulation to determine compliance with specification requirements.
DEMONSTRATION	Demonstration is the determination of properties and performance involving proof-by-doing.
INSPECTION	Inspection is the examination or measurement of product characteristics or the review of design, production or test documentation to determine compliance with specified requirements.
TEST	Test is the exercise of hardware, software, or operations to measure quantitatively specified requirements.
Joint Demonstration/Test (JD/JT)	Joint demo/test is the exercise of hardware, software, or operations that involve both the NPGS and systems provided by other parties participating in the OSTM to jointly accomplish the desired objective(s). This will include the OSTM Ground Segment Technical Integration testing activities and OSTM Ground Segment Qualification activities.

A-1 Acronyms

AAS	Archive and Access System
AD	Applicable Document
APID	Application Processor Identifier
C2	Telemetry, Command & Control
CDA	Command and Data Acquisition
CDAS	Command and Data Acquisition Station
CEMSCS	Central Environmental Satellite Computer System
CLASS	Comprehensive Large Array-data Stewardship System
CLTU	Command Link Transmission Unit
CNES	Centre Nationale D'Etudes Spatiales
COP	Command Operation Procedure
DAB	Data Archive Board
DCN	Data & Communications Network
DP	Data Processing
EET	European Earth Terminal
EIRP	Expected Isotropic Radiated Power
EUMETSAT	European Organisation for the Exploitation of Meteorological Satellites
FCDAS	Fairbanks CDAS
FDTM	Failure Diagnostic Telemetry
GDR	Geophysical Data Record
HKTM	Housekeeping Telemetry
HKTM-P	Housekeeping Telemetry-Real Time
HKTM-R	Housekeeping Telemetry-Recorded
ISE	Information Service Enterprise
JTCCS	Jason Telemetry, Command and Control Subsystem
JPL	Jet Propulsion Laboratory/NASA
JSEQ	Jason Sequencing Subsystem
LTTM	Long-Term Telemetry
NASA	National Aeronautics and Space Administration
NCDC	National Climatic Data Center
NESDIS	National Environmental Satellite, Data, and Information Service
NOAA	National Oceanic and Atmospheric Administration

NPGS	NOAA Polar Ground Segment
NPOESS	National Polar-orbiting Operational Environmental Satellite System
NRTDPS	Near Real-Time Data Processing System (NOAA)
OBDH	On-board Data Handling
OBS	On-board Software
OGDR	Operational Geophysical Data Record
OSTM	Ocean Surface Topography Mission
PACS	Polar Acquisition and Control Subsystem
PLTM	Payload Telemetry
POCC	Project Operations Control Center
POD	Precise Orbit Determination
POE	Precise Orbit Ephemeris
QPSK	Quadratic Phase Shift Keying
RD	Reference Documents
RVTM	Requirement Verification Traceability Matrix
SCT	Satellite Command Table
SDB	Satellite Database
SGDR	Sensor Geophysical Data Record
SOCC	Satellite Operations Control Center
SSALTO	Altimetry and Orbitography Ground Segment
TBC	To Be Confirmed
TBD	To Be Determined
TBS	To Be Supplied
TBW	To Be Written
TC	Telecommand, Command
TM	Telemetry
TOPEX	Ocean Topography Experiment
UTC	Universal Time Coordinated
VC	Virtual Channel
WCDAS	Wallops Command and Data Acquisition Station